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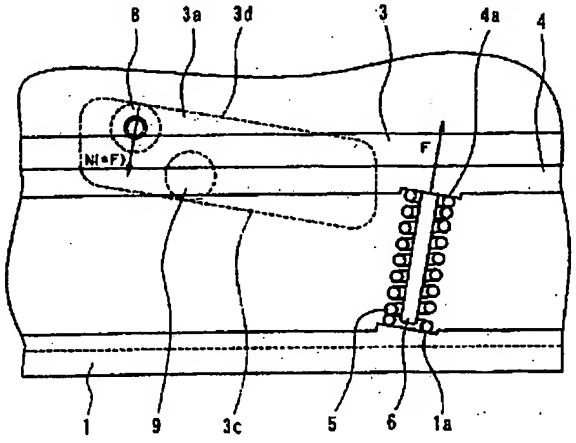
(54)【発明の名称】レンズ鏡筒

(57)【要約】

【課題】カム溝とカムフォロワーとの嵌合ガタを取り除くために、付勢部材によってカム面にカムフォロワーを押圧する構成にあって、付勢部材の付勢力が、カムフォロワーを保持する保持部材に対して回転させる方向に作用するというロスがあった。

【解決手段】付勢部材の付勢力を、保持部材を回転させることなく効率よく、カムフォロワーに伝達する付勢手段を有する。



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【特許請求の範囲】

【請求項１】レンズ群の光軸方向の移動を制御するカムが形成されたカム部材と、前記カムに当接する第１カムフォロワーが固設された保持部材と、前記カムに当接する第２カムフォロワーが固設された固定部材と、前記保持部材と前記固定部材に挟持される付勢部材とを備え、前記付勢部材の付勢力によって前記保持部材が前記固定部材から離間させられ、前記カムの一方の面に前記第１カムフォロワーが当接し、他方の面に前記第２カムフォロワーが当接するレンズ鏡筒において、

前記付勢部材の付勢力を前記保持部材を回転させることなく効率よく前記第１カムフォロワー、前記第２カムフォロワーに伝達する付勢手段を有することを特徴とするレンズ鏡筒。

【請求項２】前記付勢手段は、前記保持部材と前記固定部材とに対向する如くそれぞれに形成された前記カムの一方の面及び他方の面のいずれか一方の面と略同一方向の付勢部材保持面と、前記保持部材及び前記固定部材に形成された前記付勢部材保持面のいずれか一方の面に垂直に植設された前記付勢部材を支持する付勢部材支持部材とを有することを特徴とする請求項１記載のレンズ鏡筒。

【請求項３】前記付勢手段は、両端に固定部が形成され一方は前記保持部材に、他方は前記固定部材に固設される光軸を巻線中心とするコイルバネであることを特徴とする請求項１記載のレンズ鏡筒。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明はレンズ鏡筒に関し、特に光学系を光軸方向に移動制御させるカム機構に関する。

【０００２】

【従来の技術】従来のカム機構は、図４、図５、および図６に示す如く構成されていた。以下図面を参照して従来の技術を説明する。図４は従来のレンズ鏡筒の縦断面図、図５は従来のレンズ鏡筒のカム部材近傍の展開図、図６は従来のレンズ鏡筒のカム部材近傍の拡大展開図である。

【０００３】図４において、フォーカスレンズ群Ｌ１を保持するフォーカスレンズ群移動枠３は、固定筒１０１の内筒外周面に回動可能に嵌合している。フォーカスレンズ群移動枠３には、フォーカス量を制御するためのカム溝３ａが、円周方向等分に３箇所形成されている。固定筒１０１の内筒外周面には、第１のカムフォロワー９が円周方向等分に３箇所植設されており、この第１のカムフォロワー９は、カム溝３ａに摺動可能に嵌入している。また、フォーカスレンズ群移動枠３の内周面には、付勢部材保持筒１０４が回動可能に嵌合しており、その外周面には、円周方向等分に３箇所、第２のカムフォロワー８が植設されている。そして、第２のカムフォロワー８は、第１のカムフォロワー９と同様に、カム溝３ａに摺動可能に嵌入している。付勢部材保持筒１０４の端面には、周方向３等分位置に光軸方向に延在するピン部材６が植設されており、その先端部は、固定筒１０１の内筒部から光軸方向に伸びる鍔部に形成された３カ所の貫通孔１０１ａに貫通している。ピン部材６のそれぞれには、圧縮バネ５が挿入されており、付勢部材保持筒１０４と、これを介して固定筒１０１を付勢している。この付勢力によって、付勢部材保持筒１０４は固定筒１０１に対して離間する方向に押圧される。従って、付勢部材保持筒１０４に植設されている第２のカムフォロワー８が、カム溝３ａ内で固定筒１０１に植設された第１のカムフォロワー９に対して離間する方向に移動し、第１のカムフォロワー９はカム溝３ａの一方のカム面に当接し、第２のカムフォロワー８は他方のカム面に当接する。

【０００４】フォーカスレンズ群移動枠３には、直進溝３ｂが形成されており、この直進溝３ｂに、外部操作可能なマニュアル操作環２にビス１０によって固設された連結部材７の先端部が嵌入している。この様に構成されたレンズ鏡筒のフォーカス動作を説明する。マニュアルフォーカス環２を回転させると、連結部材７を介してフォーカスレンズ群移動枠３が回転する。フォーカスレンズ移動枠３のカム溝３ａが、固定筒１０１に植設された第１のカムフォロワー９に当接しているので、カム溝３ａに沿って回転しながら光軸方向に移動する。これによって、フォーカスレンズ群Ｌ１が光軸方向に移動してフォーカスがなされる。

【０００５】以下、図５、図６の展開図によって詳細に説明する。尚、図４にて説明した部品に関しては同一符号を付して説明を省略する。図５はカム溝３ａを含む近傍を説明する展開図である。図５において、ピン部材６にその内径部を支持された圧縮バネ５は、その付勢力によって第２のカムフォロワー８を、カム溝３ａの他方のカム面３ｃに適度な押圧力で当接させている。また、第１のカムフォロワー９は固定筒１０１の内筒部外周に植設されているので、圧縮バネ５の付勢力によってカム溝３ａの一方のカム面３ｄに当接する。

【０００６】図６は図５を更に拡大した展開図である。図６において、カム溝３ａを有する付勢部材保持筒１０４が受ける付勢力の大きさ及び方向を、矢印によって示している。圧縮バネ５によって光軸方向にＦなる付勢力を受ける。この付勢力を傾斜角θのカム溝３ａの一方のカム面３ｄで、付勢力Ｆとは傾斜角θ分だけ傾いた方向にＮ’なる力で受ける。ここでＮ’の光軸方向の成分は付勢力Ｆと釣り合っている。しかしカＦと直交する方向成分のカＰが発生する。このカＰを固定筒１０１の鍔部に形成された貫通孔１０１ａで受けることにより、付勢部材保持筒１０４の回転を押さえる如く構成している。

【０００７】以上のような構成によって、カム溝３ａと

カムフォロワー８，９との嵌合ガタを抑えることにより、より高い精度での制御を可能としていた。

【０００８】

【発明が解決しようとする課題】この様な従来の構成においては、カムフォロワーとカム溝との嵌合ガタを除去するために、付勢部材保持筒を用い、光軸と平行な方向に圧縮バネの付勢力を働かせてカムフォロワーでカム溝のカム面を押圧していた。この様な構成にあっては、光軸と平行に付勢力を働かせると、カム溝の傾斜角に影響されて、その影響分だけカム面を押圧する必要方向と、付勢部材保持筒を回転させる不必要方向に力が働く。その結果、何らかの手段を講じないと付勢部材保持筒を回転させてしまうという問題点があった。

【０００９】この問題点を解決するために、従来の技術では、固定筒の鍔部に形成された貫通孔に、圧縮バネを支持するピン部材を嵌合させることで回転力を受けるようにして、付勢部材保持筒の回転を阻止するように構成していた。しかしながらこのような構成では、ピン部材と貫通孔との間に、前記の不必要な方向の力の作用による圧縮バネ付勢方向の摩擦を生じてしまい、必要な付勢力を確実に伝達することが難しくなり（概算で傾斜角３０度において１割、傾斜角４５度で２割程度の付勢力のロスが発生する）、ガタ取りが十分に行われない恐れが生じるという問題点があった。

【００１０】また、カム溝の傾斜角の変化によって、第１カムフォロワーと第２カムフォロワーとの間隔が変わる場合には摩擦損失となるため、フォーカストルクの増大を引き起こしてしまうという問題点もあった。本発明はこのような従来の問題点に鑑みてなされたものであり、その目的とするところは、カム溝とカムフォロワーとの嵌合ガタを抑える構成において、付勢部材の付勢力によるカム部材の回転力を極力発生させず、しかも、回転力が発生する場合でもあっても、それによる付勢力のロスが起こらないように構成し、、よってカム溝に対するカムフォロワーの押圧力を効率良く伝達可能としたカム機構を備えたレンズ鏡筒を提供することにある。

【００１１】

【課題を解決するための手段】上記目的を達成するために本発明ではレンズ群の光軸方向の移動を制御するカムが形成されたカム部材と、前記カムに当接する第１カムフォロワーが固設された保持部材と、前記カムに当接する第２カムフォロワーが固設された固定部材と、前記保持部材と前記固定部材に挟持される付勢部材とを備え、前記付勢部材の付勢力によって前記保持部材が前記固定部材から離間させられ、前記カムの一方面に前記第１カムフォロワーが当接し、他方面に前記第２カムフォロワーが当接するレンズ鏡筒において、前記付勢部材の付勢力を前記保持部材を回転させることなく効率よく前記第１カムフォロワー、前記第２カムフォロワーに伝達する付勢手段を有することを第１の課題解決の手段とするものである。

【００１２】また、前記付勢手段は、前記保持部材と前記固定部材とに対向する如くそれぞれに形成された前記カムの一方の面及び他方の面のいずれか一方の面と略同一方向の付勢部材保持面と、前記保持部材及び前記固定部材に形成された前記付勢部材保持面のいずれか一方の面に垂直に植設された前記付勢部材を支持する付勢部材支持部材とを有することを第２の課題解決の手段とし、更に、前記付勢手段は、両端に固定部が形成され一方は前記保持部材に、他方は前記固定部材に固設される光軸を巻線中心とするコイルバネであることを第３の課題解決の手段とするものである。

【００１３】

【発明の実施の形態】以下、図面を参照して本発明の実施の形態を説明する、図１は本発明の第１の実施形態を示すレンズ鏡筒の縦断面図、図２は第１の実施形態のカム部材近傍の展開図、図３は第１の実施形態のカム部材近傍の拡大展開図である。

【００１４】図１において、フォーカスレンズ群Ｌ１を保持するフォーカスレンズ群移動枠３は、固定筒１の内筒外周面に回動可能に嵌合している。フォーカスレンズ群移動枠３には、フォーカス量を制御するためのカム溝３ａが、円周方向等分に３箇所形成されている。固定筒１の内筒外周面には、第１カムフォロワー９が円周方向等分に３箇所植設されており、この第１カムフォロワー９は、カム溝３ａの端面に沿って摺動可能に嵌入している。また、フォーカスレンズ群移動枠３の内周面には、付勢部材保持筒４が回動可能に嵌合しており、その外周面には、円周方向等分に３箇所、第２カムフォロワー８が植設されている。そして、第２カムフォロワー８は、第１カムフォロワー９と同様に、カム溝３ａに摺動可能に嵌入している。付勢部材保持筒４の端面には、カム溝３ａの端面に対して直交する方向にピン部材６が周方向３等分に植設されている。また、ピン部材６には圧縮バネ５が挿入されている。そして圧縮バネ５は、付勢部材保持筒４と固定筒１との間に挟持されており、固定筒１に形成されたカム溝３ａの端面と同方向の胴付面を支点として、付勢部材保持４を付勢している。この付勢力によって、付勢部材保持筒４は固定筒１に対して離間する方向に押圧される。従って、付勢部材保持筒４に植設されている第２カムフォロワー８がカム溝３ａ内で固定筒１に植設された第１カムフォロワー９に対して離間する方向に移動し、第１カムフォロワー９はカム溝３ａの一方のカム面に当接し、第２カムフォロワー８は他方のカム面に当接する。

【００１５】フォーカスレンズ群移動枠３には、直進溝３ｂが形成されており、この直進溝３ｂに、外部操作可能なマニュアル操作環２にビス１０によって固設された連結部材７の先端部が嵌入している。この様に構成されたレンズ鏡筒のフォーカス動作を説明する。マニュアル

フォーカス環２を回転させると、連結部材７を介してフォーカスレンズ群移動枠３が回転する。フォーカスレンズ移動枠３のカム溝３ａが、固定筒１に植設された第１カムフォロワー９に当接しているので、カム溝に沿って回転しながら光軸方向に移動する。これによって、フォーカスレンズ群Ｌ１が光軸方向に移動してフォーカスがなされる。

【００１６】以下、図２、図３の展開図によって詳細に説明する。尚、図１にて説明した部品に関しては同一符号を付して説明を省略する。図２はカム溝３ａを含む近傍を展開している。図２において、付勢部材保持筒４に形成された、カム面３ｃ、３ｄと同一方向の端面４ａに植設されたピン部材６に、その内径部を支持された圧縮バネ５は、固定筒に形成された、前記端面４ａに対向する胴付面を支点とする付勢力によって第２カムフォロワー８を、カム溝３ａの他方のカム面３ｃに必要な押圧力で当接させている。また、この作用に関連して、第１カムフォロワー９は固定筒１の内筒部外周に植設されているので、圧縮バネ５の付勢力によってカム溝３ａの一方のカム面３ｄに当接する。

【００１７】図３は図２を更に拡大している。図３において、カム溝３ａを有する付勢部材保持筒４が受ける付勢力の大きさ及び方向を矢印によって表している。圧縮バネ５によって付勢部材保持筒４はカム溝３ａのカム面３ｃ，３ｄに対して直交する方向にＦなる付勢力を受ける。この付勢力をカム溝３ａの一方のカム面３ｄで、付勢力Ｆと同一方向にＮなる力で受ける。ここでＮの付勢力Ｆ方向の成分は付勢力Ｆと釣り合っている。そして付勢力Ｆと垂直方向成分の力は発生しない。

【００１８】上記の如く第１の実施形態にあっては、付勢部材保持筒４に回転力が発生しないので、それを阻止するための構成を必要としない。図７は本発明の第２の実施形態を示すレンズ鏡筒の縦断面図である。尚、第２の実施形態を説明するにあたって、図１と同一部材については同一符号を付して説明を省略する。

【００１９】図７において、固定筒１と付勢部材保持筒４との間には、図８に示す如きコイルバネ１１が配置されている。コイルバネ１１は、両端部にバネ掛け部１１ａ，１１ｂが形成されており、それぞれ固定筒１と付勢部材保持筒４に支持されている。これにより、コイルバネ１１の弾性によって発生する光軸方向の付勢力で、カム溝３ａとカムフォロワー８，９との間のガタが抑えられる。この様な構成にあっては、上述と同様に付勢部材保持筒４は回転力を受けるが、その回転力は、コイルバネ１１の光軸回りのねじり弾性力によって打ち消すことを可能としている。従って、付勢部材保持筒４は回転しない。

【００２０】

【発明の効果】以上のように本発明によれば、カムが形成されたカム部材と、カムに当接する第１カムフォロワーが固設された保持部材と、カムに当接する第２カムフォロワーが固設された固定部材と、保持部材と固定部材に挟持される付勢部材とを備え、付勢部材の付勢力によって保持部材が固定部材から離間させられ、カムの一方の面に第１カムフォロワーが当接し、他方の面に第２カムフォロワーが当接するレンズ鏡筒において、付勢部材の付勢力を保持部材を回転させることなく効率よく第１カムフォロワー、第２カムフォロワーに伝達する付勢手段を有する如くなしたので、付勢力をカム溝に対するガタ取りに確実に作用させることが出来るという効果を奏するものである。

【００２１】また、付勢手段は、保持部材と固定部材とに対向する如くそれぞれに形成された、カムの一方の面及び他方の面のいずれか一方の面と略同一方向の付勢部材保持面と、保持部材及び固定部材に形成された付勢部材保持面のいずれか一方の面に垂直に植設された付勢部材を支持する付勢部材支持部材とを備えたので、付勢部材の付勢力はカム面に直交に作用して、保持部材に回転力を与えない。従って、回転力を打ち消すための構成を必要としないので、構成が簡略化されるという効果もある。

【００２２】更に、付勢手段は、両端に固定部が形成され一方は保持部材に、他方は固定部材に固設される光軸を巻線中心とするコイルバネとしたので、そのねじり弾性力によって保持部材の回転力を吸収するようになっているので、部品点数の削減をすることが出来るという効果を奏する。また、カムの傾斜角の変化によって、第１カムフォロワーと第２カムフォロワーとの間隔が変わる場合でも摩擦損失となることがなく、フォーカストルクの増大を引き起こす心配もないという効果もある。

【図面の簡単な説明】

【図１】本発明の第１の実施形態を示すレンズ鏡筒の縦断面図である。

【図２】第１の実施形態のカム部材近傍の展開図である。

【図３】図２を拡大した拡大展開図である。

【図４】従来のレンズ鏡筒の縦断面図である。

【図５】従来のレンズ鏡筒のカム部材近傍の展開図である。

【図６】従来のレンズ鏡筒のカム部材近傍の拡大展開図である。

【図７】本発明の第２の実施形態を示すレンズ鏡筒の縦断面図である。

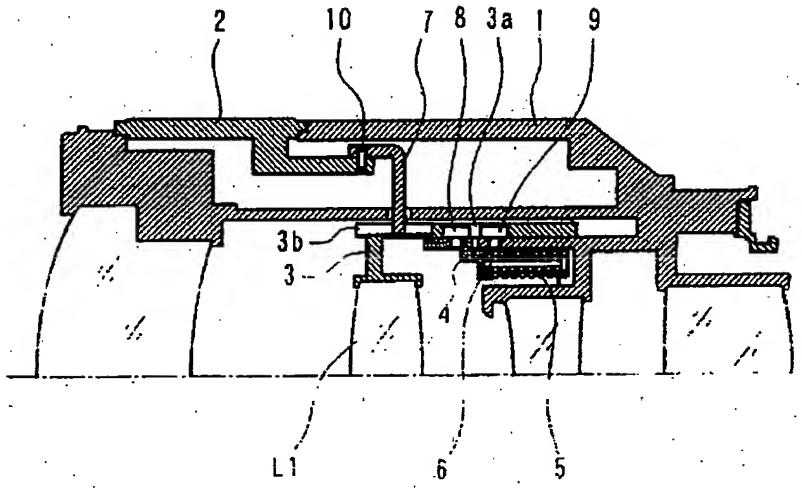
【図８】第２の実施形態の付勢部材を説明する図である。

【符号の説明】

１　固定筒
１ａ　胴付面
２　マニュアル操作環
３　フォーカスレンズ移動枠

3 a　カム溝
3 b　直進溝
3 c　他方のカム面
3 d　一方のカム面
4　付勢部材保持筒
4 a　端面
5　圧縮バネ
6　ピン部材
7　連結部材
8　第２カムフォロワー
9　第１カムフォロワー

【図１】



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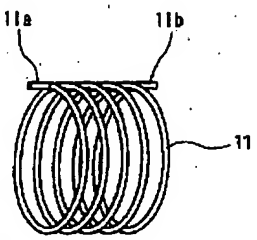

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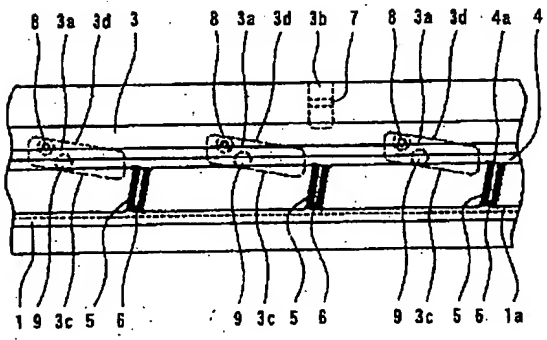

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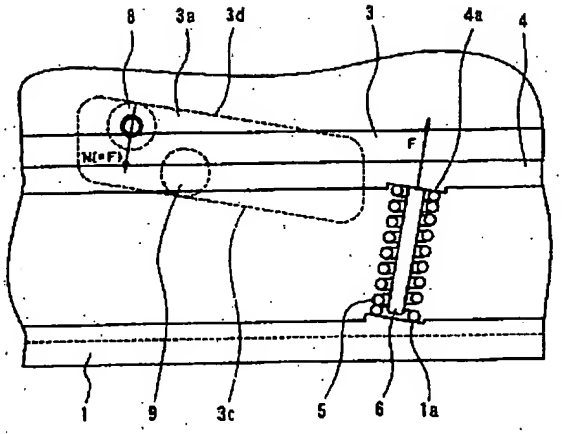

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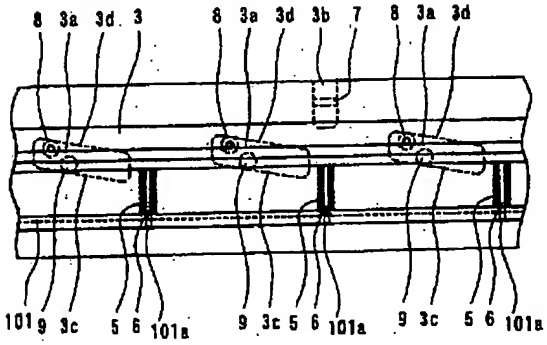

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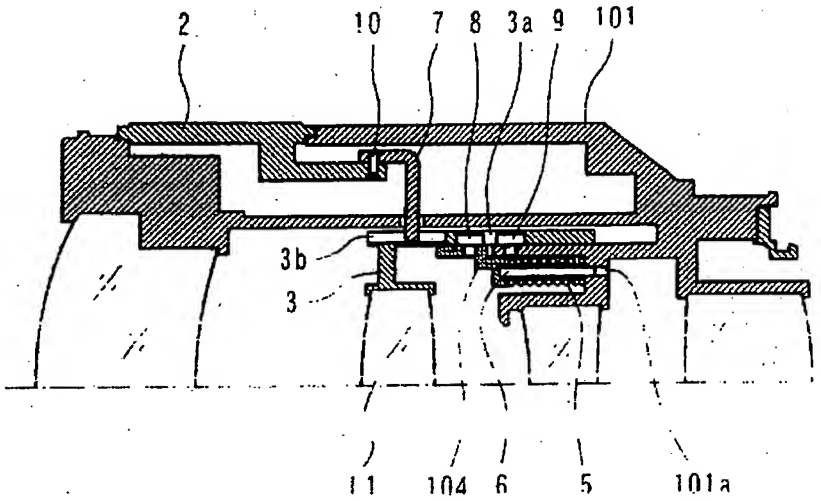
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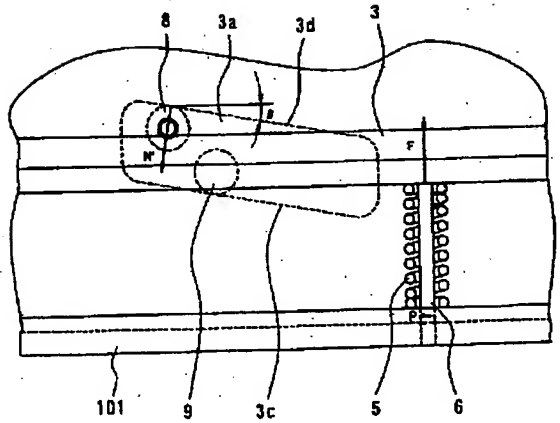
10
7
8
3a
9
101
3b
3
11
104
6
5
101a

【図６】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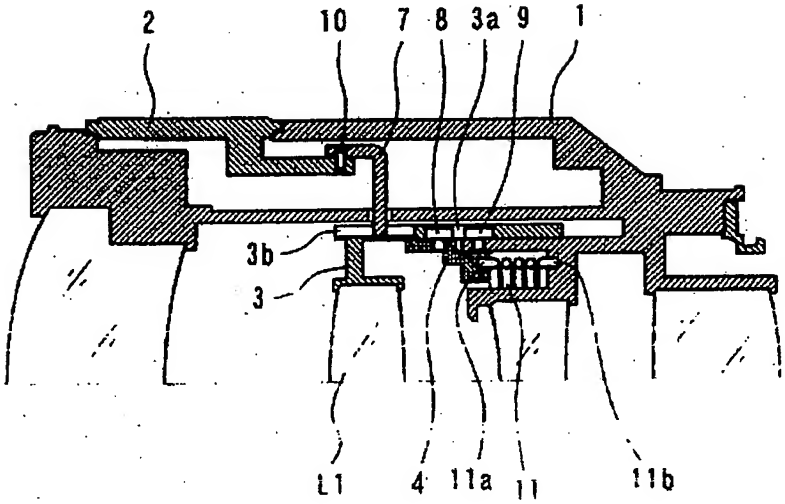
3a
3d
3
101
9
3c
5
6

【図７】


2
10
7
8
3a
9
1
3b
3
L1
4
11a
11
11b

特開平 11-119079

訳注

以下のように読替えて作業しております。ご確認下さい。

段落［0006］最終行

「…104 の回転を押える如く…」->「…104 の回転を抑える如く…」

段落［0014］下から 12 行目

「… 3 等分に植設されている。」->「… 3 等分位置に植設されている。」

段落［0014］下から 8 行目

「…付勢部材保持４を付勢している」->「…付勢部材保持筒４を付勢している」

以上

Date: October 7, 2005

Declaration

I, Mariko Uchida, a translator of Fukuyama Sangyo Honyaku Center, Ltd., of 16-3, 2-chome, Nogami-cho, Fukuyama, Japan, do solemnly and sincerely declare that I understand well both the Japanese and English languages and that the attached document in English is a full and faithful translation of the copy of Japanese Unexamined Patent No. Hei-11-119079 laid open on April 30, 1999.

Mariko Uchida

Mariko Uchida

Fukuyama Sangyo Honyaku Center, Ltd.

LENS BARREL

Japanese Unexamined Patent No. Hei-11-119079

Laid-open on: April 30, 1999

Application No. Hei-9-286848

Filed on: October 20, 1997

Applicant: Nikon Corporation

Inventor: Koji YOSHIBE

SPECIFICATION

[TITLE OF THE INVENTION] Lens Barrel

[ABSTRACT]

[Object] In a construction for pressing cam followers against a cam face by a charging member in order to eliminate a fitting backlash between a cam groove and cam followers, the construction has suffered a loss such that a charging force of the charging member acts on a holding member that holds the cam followers in a direction to rotate the same.

[Solution means] Having a charging means to efficiently transmit a charging force of the charging member to the cam followers without rotating the holding member.

[WHAT IS CLAIMED IS;]

[Claim 1] A lens barrel comprising: cam members where cams for controlling a shift of a lens group in an optical axis direction have been formed; a holding member where first cam followers brought in contact with the cams have been provided in a fixed condition; a fixing member where second cam followers brought in contact with the cams have been provided in a fixed condition; and charging members sandwiched by the holding member and fixing member, the holding member being alienated from the fixing member by a charging force of the charging members, the first cam followers being brought in contact with one-side faces of the cams, and the second cam followers being brought in contact with other-side faces of the cams, wherein

the lens barrel has a charging means for efficiently transmitting a charging force of the charging members to the first cam followers and second cam followers without rotating the holding member.

[Claim 2] The lens barrel according to Claim 1, wherein

the charging means has charging member holding faces almost identical in direction to either one-side face or the other-side face of the cams, formed in such a manner as being opposed to the holding member and fixing member, on each thereof, and a charging member supporting member for supporting the charging member vertically implanted in either one of the

charging member holding faces formed on the holding member and fixing member.

[Claim 3] The lens barrel according to Claim 1, wherein

the charging means is a coil spring around an optical axis as a winding center for which, at both ends, fixing portions are formed, one of which is provided in a fixed condition on the holding member, and the other, on the fixing member.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the Invention] The present invention relates to a lens barrel, and in particular, to a cam mechanism for controlling by shifting an optical system in the optical axis direction.

[0002]

[Prior Arts] A conventional cam mechanism has been constructed as shown in Fig. 4, Fig. 5, and Fig. 6. Hereinafter, a prior art will be described with reference to the drawings. Fig. 4 is a longitudinal sectional view of a conventional lens barrel. Fig. 5 is a development view in the vicinity of cam members of the conventional lens barrel. Fig. 6 is an enlarged development view in the vicinity of cam members of the conventional lens barrel.

[0003] In Fig. 4, a focus lens group shifting frame 3 that holds

a focus lens group L1 is rotatably fitted with an inner-cylinder outer circumferential surface of a fixing cylinder 101. On the focus lens group shifting frame 3, cam grooves 3a for controlling the focusing amount are formed at three points equally divided in the circumferential direction. In the inner-cylinder outer circumferential surface of the fixing cylinder 101, first cam followers 9 are implanted at three points equally divided in the circumferential direction, and these first cam followers 9 are slidably fitted in the cam grooves 3a. Moreover, with an inner circumferential surface of the focus lens group shifting frame 3, a charging member holding cylinder 104 is rotatably fitted, and in an outer circumferential surface thereof, at three points equally divided in the circumferential direction, second cam followers 8 are implanted. And, the second cam followers 8 are, similar to the first cam followers 9, slidably fitted in the cam grooves 3a. In an end face of the charging member holding cylinder 104, pin members 6 that are present in an extended condition in the optical axis direction are implanted at three equally-divided circumferential positions, and front-end portions thereof are penetrated through three through-holes 101a formed in a flange portion that extends in the optical axis direction from an inner cylinder portion of the fixing

cylinder 101. In each of the pin members 6, inserted is a compression spring 5, which charges the charging member holding cylinder 104 and the fixing cylinder 101 via the same. By this charging force, the charging member holding cylinder 104 is pressed in a direction to be alienated from the fixing cylinder 101. Accordingly, the second cam followers 8 implanted in the charging member holding cylinder 104 are shifted in a direction to be alienated from the first cam followers 9 implanted in the fixing cylinder 101 within the cam grooves 3a, whereby the first cam followers 9 are brought in contact with one-side cam faces of the cam grooves 3a, while the second cam followers 8 are brought in contact with the other-side cam faces.

[0004] On the focus lens group shifting frame 3, a straight advancing groove 3b is formed, and in this straight advancing groove 3b, a front-end portion of a joint member 7 provided in a fixed condition on an externally operable manual operating ring 2 by a screw 10 is fitted. Focusing operations of the lens barrel constructed as such will be described. When the manual focusing ring 2 is rotated, the focus lens group shifting frame 3 is rotated via the joint member 7. Since the cam grooves 3a of the focus lens shifting frame 3 have been brought in contact with the first cam followers 9 implanted in the fixing cylinder 101, these are shifted in the optical axis direction

while being rotated along the cam grooves 3a. Thereby, the focus lens group L1 is shifted in the optical axis direction so as to carry out focusing.

[0005] Hereinafter, description will be given in detail according to the development views of Fig. 5 and Fig. 6. Here, for components that have been described in Fig. 4, identical symbols will be used so as to omit description. Fig. 5 is a development view for explaining vicinities including cam grooves 3a. In Fig. 5, the compression springs 5 whose inside-diametrical portions have been supported by the pin members 6 bring, by a charging force of the same, the second cam followers 8 in contact with the other-side cam faces 3c of the cam grooves 3a at an appropriate pressing force. In addition, since the first cam followers 9 have been implanted in the outer circumference of an inner cylinder portion of the fixing cylinder 101, these are brought in contact with one-side cam faces 3d of the cam grooves 3a by a charging force of the compression springs 5.

[0006] Fig. 6 is a development view by a further enlargement of Fig. 5. In Fig. 6, a magnitude and direction of a charging force which the charging member holding cylinder 104 having the cam grooves 3a receives is shown by an arrow. Owing to the compression spring 5, the charging member holding cylinder

104 receives a charging force of F in the optical axis direction. This charging force is received, on the one-side cam face 3d of the cam groove 3a having an inclination angle θ, at a force of N′ in a direction inclined by a degree of the inclination angle θ from the charging force F. Here, a component of N′ in the optical axis direction balances with the charging force F. However, a force P of a direction component orthogonal to the force F is generated. By receiving this force P at the through-hole 101a formed in the flange portion of the fixing cylinder 101, a construction is provided such as to suppress rotation of the charging member holding cylinder 104.

[0007] By suppressing a fitting backlash between the cam groove 3a and cam followers 8 and 9 by such a construction as in the above, control at a higher accuracy has been enabled.

[0008]

[Problems to be Solved by the Invention] In such a conventional construction, in order to eliminate a fitting backlash between the cam followers and cam groove, by use of the charging member holding cylinder, a charging force of the compression spring is exerted in a direction parallel to the optical axis so as to press the cam face of the cam groove by the cam followers. With such a construction, when the charging force is exerted in parallel to the optical axis, owing to an influence of the

inclination angle of the cam groove, by a degree of this influence, a force is exerted in a necessary direction to press the cam face and an unnecessary direction to rotate the charging member holding cylinder. As a result, there has been a problem in that the charging member holding cylinder is rotated unless some measures are taken.

[0009] In order to solve this problem, according to the prior art, by receiving a rotating force by fitting the pin member that supports the compression spring with the through-hole formed in the flange portion of the fixing cylinder, a construction has been provided so as to prevent rotation of the charging member holding cylinder. However, in such a construction, friction in a compression spring charging direction owing to an action of force in the above-mentioned unnecessary direction is generated between the pin member and through-hole, it becomes difficult to securely transmit a necessary charging force (in a rough estimate, a loss in the charging force of approximately ten percent occurs at an inclination angle of 30 degrees, and twenty percent, at an inclination angle of 45 degrees), and there has been a problem in that the possibility of an insufficient backlash elimination arises.

[0010] In addition, there has also been a problem in that, since

a change in the interval between the first cam follower and second cam follower owing to a change in the inclination angle of the cam groove results in a friction loss, this causes an increase in focusing torque. The present invention has been made in view of such conventional problems, and an object thereof is to provide a lens barrel provided with a cam mechanism constructed so that, in a construction for suppressing a fitting backlash between a cam groove and cam followers, a rotating force of cam members owing to a charging force of a charging member is not generated as much as possible and, even when a rotating force is generated, a loss in a charging force owing thereto does not occur, and thereby making it possible to efficiently transmit a pressing force of the cam followers to the cam groove.

[0011]

[Means for Solving the Themes] In order to achieve the above-mentioned object, according to the present invention, a first means for solving the themes is a lens barrel comprising: cam members where cams for controlling a shift of a lens group in an optical axis direction have been formed; a holding member where first cam followers brought in contact with the cams have been provided in a fixed condition; a fixing member where second cam followers brought in contact with the

cams have been provided in a fixed condition; and charging members sandwiched by the holding member and fixing member, the holding member being alienated from the fixing member by a charging force of the charging members, the first cam followers being brought in contact with one-side faces of the cams, and the second cam followers being brought in contact with other-side faces of the cams, wherein the lens barrel has a charging means for efficiently transmitting a charging force of the charging members to the first cam followers and second cam followers without rotating the holding member.

[0012] In addition, a second means for solving the problems is that the charging means has charging member holding faces almost identical in direction to either one-side face or the other-side face of the cams, formed in such a manner as being opposed to the holding member and fixing member, on each thereof, and a charging member supporting member for supporting the charging member vertically implanted in either one of the charging member holding faces formed on the holding member and fixing member. Furthermore, a third means for solving the problems is that the charging means is a coil spring around an optical axis as a winding center for which, at both ends, fixing portions are formed, one of which is provided in a fixed condition on the holding member, and the other, on the fixing

member.

[0013]

[Embodiment of the Invention] Hereinafter, an embodiment of the present invention will be described with reference to the drawings. Fig. 1 is a longitudinal sectional view of a lens barrel showing a first embodiment of the present invention, Fig. 2 is a development view in the vicinity of cam members of the first embodiment, and Fig. 3 is an enlarged development view in the vicinity of cam members of the first embodiment.

[0014] In Fig. 1, a focus lens group shifting frame 3 that holds a focus lens group L1 is rotatably fitted with an inner-cylinder outer circumferential surface of a fixing cylinder 1. On the focus lens group shifting frame 3, cam grooves 3a for controlling the focusing amount are formed at three points equally divided in the circumferential direction. In the inner-cylinder outer circumferential surface of the fixing cylinder 1, first cam followers 9 are implanted at three points equally divided in the circumferential direction, and these first cam followers 9 are fitted so as to be slidable along end faces of the cam grooves 3a. Moreover, with an inner circumferential surface of the focus lens group shifting frame 3, a charging member holding cylinder 4 is rotatably fitted, and in an outer circumferential surface thereof, at three

points equally divided in the circumferential direction, second cam followers 8 are implanted. And, the second cam followers 8 are, similar to the first cam followers 9, slidably fitted in the cam grooves 3a. In an end face of the charging member holding cylinder 4, pin members 6 are implanted at three equally-divided circumferential positions in a direction orthogonal to the end faces of the cam grooves 3a. Moreover, in the pin members 6, compression springs 5 are inserted. And, the compression springs 5 are sandwiched between the charging member holding cylinder 4 and fixing cylinder 1, and charge the charging member holding cylinder 4 while using a body fitting face, formed on the fixing cylinder 1, the same direction as the end faces of the cam grooves 3a as a fulcrum. By this charging force, the charging member holding cylinder 4 is pressed in a direction to be alienated from the fixing cylinder 1. Accordingly, the second cam followers 8 implanted in the charging member holding cylinder 4 are shifted in a direction to be alienated from the first cam followers 9 implanted in the fixing cylinder 1 within the cam grooves 3a, whereby the first cam followers 9 are brought in contact with one-side cam faces of the cam grooves 3a, while the second cam followers 8 are brought in contact with the other-side cam faces.

[0015] On the focus lens group shifting frame 3, a straight advancing groove 3b is formed, and in this straight advancing groove 3b, a front-end portion of a joint member 7 provided in a fixed condition on an externally operable manual operating ring 2 by a screw 10 is fitted. Focusing operations of the lens barrel constructed as such will be described. When the manual focusing ring 2 is rotated, the focus lens group shifting frame 3 is rotated via the joint member 7. Since the cam grooves 3a of the focus lens shifting frame 3 have been brought in contact with the first cam followers 9 implanted in the fixing cylinder 1, these are shifted in the optical axis direction while being rotated along the cam grooves 3a. Thereby, the focus lens group L1 is shifted in the optical axis direction so as to carry out focusing.

[0016] Hereinafter, description will be given in detail according to the development views of Fig. 2 and Fig. 3. Here, for components that have been described in Fig. 1, identical symbols will be used so as to omit description. Fig. 2 is a development of vicinities including the cam grooves 3a. In Fig. 2, the compression springs 5 whose inside-diametrical portions have been supported by the pin members 6 implanted in end faces 4a, formed on the charging member holding cylinder 4, identical in direction to cam faces 3c and 3d bring, by a

charging force using the body fitting face, formed on the charging member holding cylinder 4, opposed to the end faces 4a as a fulcrum, the second cam followers 8 in contact with the other-side cam faces 3c of the cam grooves 3a at a necessary pressing force. In addition, in relation to this action, since the first cam followers 9 have been implanted in the outer circumference of an inner cylinder portion of the fixing cylinder 1, these are brought in contact with the one-side cam faces 3d of the cam grooves 3a by a charging force of the compression springs 5.

[0017] Fig. 3 is a further enlargement of Fig. 2. In Fig. 3, a magnitude and direction of a charging force which the charging member holding cylinder 4 having the cam grooves 3a receives is shown by an arrow. Owing to the compression spring 5, the charging member holding cylinder 4 receives a charging force of F in a direction orthogonal to the cam faces 3c and 3d of the cam grooves 3a. This charging force is received, on the one-side cam face 3d of the cam groove 3a, at a force of N in a direction identical to that of the charging force F. Here, a component of N in the charging force F direction balances with the charging force F. And, no force of a direction component vertical to the charging force F is generated.

[0018] As mentioned above, in the first embodiment, since no

rotating force is generated in the charging member holding cylinder 4, no construction for preventing the same is required. Fig. 7 is a longitudinal sectional view of a lens barrel showing a second embodiment of the present invention. Here, to describe the second embodiment, identical symbols will be used for members identical to those of Fig. 1 so as to omit description.

[0019] In Fig. 7, between the fixing cylinder 1 and charging member holding cylinder 4, a coil spring 11 as shown in Fig. 8 is arranged. For the coil spring 11, spring hanger portion 11a and 11b are formed at both end portions, which are supported by the fixing cylinder 1 and charging member holding cylinder 4, respectively. Thereby, by a charging force in the optical axis direction generated by elasticity of the coil spring 11, a backlash between the cam groove 3a and cam followers 8 and 9 is suppressed. In such a construction, although the charging member holding cylinder 4 receives a rotating force similar to the above, it is possible to cancel out this rotating force by a torsional elastic force of the coil spring 11 around the optical axis. Accordingly, the charging member holding cylinder 4 is not rotated.

[0020]

[Effects of the Invention] As in the above, according to the

present invention, provided is a lens barrel comprising: cam members where cams have been formed; a holding member where first cam followers brought in contact with the cams have been provided in a fixed condition; a fixing member where second cam followers brought in contact with the cams have been provided in a fixed condition; and charging members sandwiched by the holding member and fixing member, the holding member being alienated from the fixing member by a charging force of the charging members, the first cam followers being brought in contact with one-side faces of the cams, and the second cam followers being brought in contact with other-side faces of the cams, wherein the lens barrel has a charging means for efficiently transmitting a charging force of the charging members to the first cam followers and second cam followers without rotating the holding member, therefore, the present invention provides an effect such that the charging force can be securely made to act on a backlash elimination to the cam grooves.

[0021] In addition, the charging means is provided with charging member holding faces almost identical in direction to either one-side face or the other-side face of the cams, formed in such a manner as being opposed to the holding member and fixing member, on each thereof and a charging member

supporting member for supporting the charging member vertically implanted in either one of the charging member holding faces formed on the holding member and fixing member, therefore, a charging force of the charging members orthogonally acts on the cam faces and does not give a rotating force to the holding member. Accordingly, since no construction to cancel out the rotating force is required, the present invention also has an effect such that the construction is simplified.

[0022] Furthermore, since the charging means is provided as a coil spring around an optical axis as a winding center for which, at both ends, fixing portions are formed, one of which is provided in a fixed condition on the holding member, and the other, on the fixing member, a rotating force of the holding member is absorbed by a torsional elastic force thereof, therefore, an effect such that the number of components can be reduced is achieved. In addition, the present invention also has an effect such that even a change in the interval between the first cam follower and second cam follower owing to a change in the inclination angle of the cam groove does not result in a friction loss, and there is no concern that this causes an increase in focusing torque.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] A longitudinal sectional view of a lens barrel showing a first embodiment of the present invention.

[Fig. 2] A development view in the vicinity of cam members of the first embodiment.

[Fig. 3] An enlarged development view by enlargement of Fig. 2.

[Fig. 4] A longitudinal sectional view of a conventional lens barrel.

[Fig. 5] A development view in the vicinity of cam members of the conventional lens barrel.

[Fig. 6] An enlarged development view in the vicinity of cam members of the conventional lens barrel.

[Fig. 7] A longitudinal sectional view of a lens barrel showing a second embodiment of the present invention.

[Fig. 8] A view for explaining a charging member of the second embodiment.

[Description of Symbols]

1 Fixing cylinder

1a Body fitting face

2 Manual operation ring

3 Focus lens shifting frame

3a Cam groove

3b Straight advancing groove

3c Other-side cam face

3d One-side cam face

4 Charging member holding cylinder

4a End face

5 Compression spring

6 Pin member

7 Joint member

8 Second cam follower

9 First cam follower

Fig.8

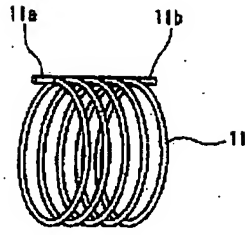


Fig.1

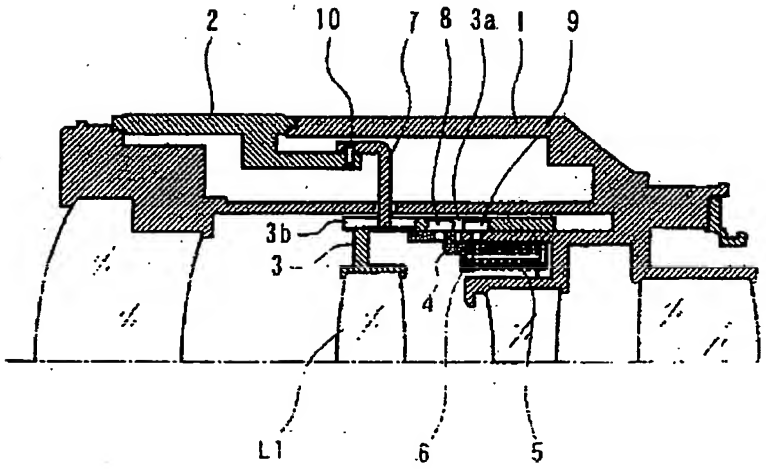


Fig.2

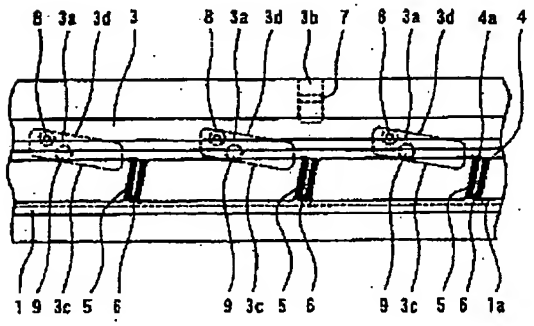


Fig.3

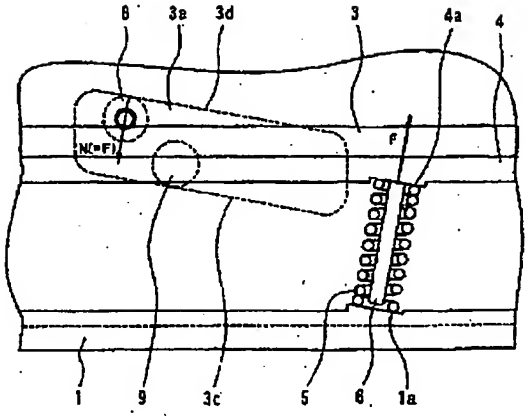


Fig.5

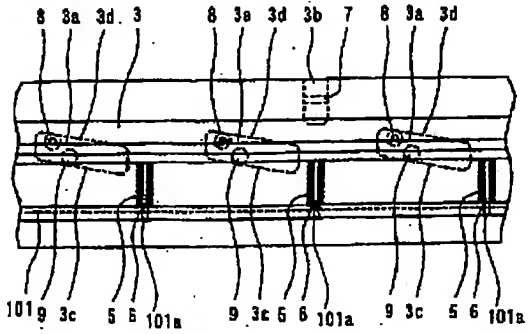


Fig.4

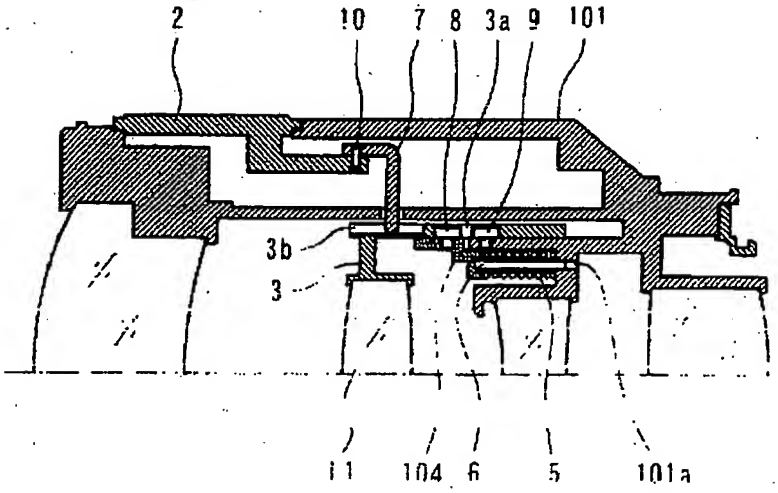


Fig.6

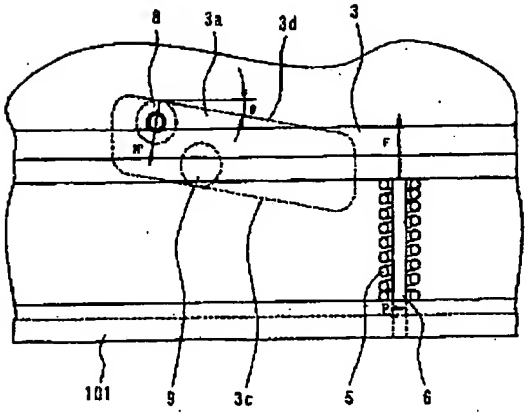


Fig.7